

**What is claimed is:**

1. A helium-free TEA CO<sub>2</sub> laser comprising:  
a pulser, a laser head comprising a pair of electrodes, a gaseous medium comprising a mixture of CO<sub>2</sub>, N<sub>2</sub> and, optionally, H<sub>2</sub>, adapted to be pre-conditioned/pre-ionised in the inter-electrode volume by a suitable means; said pulser comprising an excitation circuit comprising (i) means to isolate spiker and sustainer pulses and (ii) means to delay the spiker pulse with respect to the pre-ionising pulse.
2. A helium-free TEA CO<sub>2</sub> laser according to claim 1 wherein said excitation circuit comprises single switch and single high voltage d-c source.
3. A helium-free TEA CO<sub>2</sub> laser according to claim 1 wherein said means to isolate the spiker and sustainer pulses and said means to delay the spiker pulse with respect to the preionising pulse, comprise a wire wound inductance connected between ground and the corresponding electrode.
4. A helium-free TEA CO<sub>2</sub> laser according to claim 1, comprising means to vary the peak power, duration and energy of laser pulse.
5. A helium-free TEA CO<sub>2</sub> laser according to claim 4 wherein, said means to vary the peak power, duration and energy of the laser pulse comprises means to vary the partial pressure of CO<sub>2</sub> in the gaseous lasing medium of N<sub>2</sub> and CO<sub>2</sub> from 10% to 90% of the total pressure.
6. A helium-free TEA CO<sub>2</sub> laser according to claim 5 wherein said means to vary the partial pressure of CO<sub>2</sub> comprises suitable valve means.

7. A helium-free TEA CO<sub>2</sub> laser according to claim 1, wherein said pair of electrodes is selected from profiled, cylindrical, or unprofiled electrodes with rounded off edges.
8. A helium-free TEA CO<sub>2</sub> laser according to claim 1 wherein said suitable means for preionising the said gas mixture in the inter-electrode volume comprises sparks produced between a plurality of pairs of preionising cylindrical metallic pins, positioned along the length of the said electrodes, one above the other with a uniform gap and located at an optimum distance on either or any one side of the said electrodes at regular intervals.
9. A helium-free TEA CO<sub>2</sub> laser according to claim 1 wherein one of said pair of electrodes is semi transparent.
10. A helium-free TEA CO<sub>2</sub> laser according to claim 9 wherein means for preionising the said gas mixture in the inter-electrode volume comprises sparks produced between the semi-transparent electrode and a plurality of uniformly spaced preionising cylindrical metallic pins, positioned beneath and along the length of the said semi-transparent electrode.
12. A helium-free TEA CO<sub>2</sub> laser according to claim 1 wherein the said inter-electrode volume is selected from 1 cm<sup>3</sup> to 200 cm<sup>3</sup>.
13. A helium-free TEA CO<sub>2</sub> laser according to claim 1 wherein the operating efficiency on TEM<sub>00</sub> mode is about 5.2% for the Ernst profiled system as described in embodiment 1.